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Ponderosa pine
Roots

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A BRIEF REPORT ON

PONDEROSA PINE ROOT STUDIES

by

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INTRODUCTION

A study of root penetration and development of natural ponderosa pine seedlings was begun at the Boise Basin Experiment Station during the summer of 1935. This study was divided into two phases, (a) the development of first year seedlings on a fresh burn (August 1934) versus a virgin timber area, and, (b) measurement of differences between roots of several-aged seedlings on a cut-over area.

Field Procedure

First Year Seedling Development Phase: Four aspects were selected within the burn, and three within the virgin area. For the burn these were southeast, southwest, upper northeast and lower northeast; for the virgin north, south, and northeast flat. Beginning on June 1, two trees were dug from each aspect, first at intervals of fifteen days, and later on in the season only at intervals of thirty days because the job of sampling all aspects within a limited time proved excessive, owing to the rapid growth of the roots.

On each sampling date soil samples were taken on each site at depths of five, nine, and eighteen inches. These depths were selected to represent surface moisture zone, general root zone of annuals, etc., and zone into which pine seedling roots penetrate but most annuals do not.

The actual digging technique consisted of stretching a #18 iron wire at the ground surface to divide the probable lateral zone of the seedling roots into north, east, south, and west quadrants, with the seedling at the origin, and then carefully removing the soil by the aid of a trowel, an ice pick, and water from an automatic spray pump.

First the number and length of laterals over three inches long or shorter rapidly growing laterals for each six inch depth zone within each quadrant were recorded. In later records the area these roots occupied when projected to the bottom of the six inch zone, and the estimated volume of soil occupied by each root were also recorded. This additional information was found desirable after considerable difficulty had been encountered in attempting to calculate the volume of soil occupied by the laterals when only the total length was given. In estimating the volume of soil occupied by a root, a lateral with $\frac{1}{2}$ inch sub-laterals, for example, was assumed to occupy a cylindrical volume one inch in diameter.

The total depth of each lateral over ten inches in length which passed from one six inch zone to another was also recorded. In measuring the total depth penetrated by the root, the maximum depth was recorded regardless of whether this maximum was of a lateral or a tap. The above procedure was necessary because in many instances tap roots were found dead even above depths of twelve inches, while a lateral branching out above the dead portion would assume the leadership and form the new tap.

Several-aged Seedlings on a Cut-over Area: In this phase of the study seedlings were selected from situations on each of the four cardinal aspects. Selection was confined to areas of deep soil with a minimum of shade and competition, i.e., old landings and similar places where most of the vegetation had been destroyed. However, none was dug from places where more than two to three inches of the surface soil had been disturbed.

In 1935 one, two, and three year old seedlings comprised the several-age classes. Four seedlings of each age class were taken on each aspect at the start of the study. So much variation was found between aspects and even within aspects, that later samplings have been confined to southerly aspects only in order to obtain a satisfactorily small mean standard error without increasing the sample numbers materially to achieve this end.

The actual field technique of this phase was identical with that of the developmental phase except that soil moisture samples were taken only on a single date for the whole group of seedlings and in addition three complete sets of soil samples for mechanical analysis were taken on each aspect at twelve inch intervals down to the depth of the deepest sample root on a given aspect.

Laboratory and Office Procedure

First Year Seedling Development Phase: For each date a representative sample from both areas was photographed. Later it became evident from the marked differences between individual samples from different aspects, and even from the same aspect that each individual from each aspect within an area should have been photographed separately.

The number of laterals on each seedling was recorded, and their length, if 0.1 inch or longer, for each one inch depth zone proceeding from the root collar. Laterals were separated into three categories, those less than 0.1 inch long, those with sub-laterals, and those without sub-laterals, because it was observed that the ones with the sub-laterals appeared to develop at a more rapid rate while those less than 0.1 inch appeared dormant or dead.

Roots and top were separately dried at 100°C for twelve hours, and weighed to the nearest milligram. The soil samples were oven-dried at 100°C for twenty-four hours and the percentage of moisture calculated on the basis of oven-dry weight. In addition moisture equivalents were determined and the available moisture calculated therefrom.

Several-aged Seedlings from Cut-over Area: Representative seedlings of each age class from aspect were photographed.

Pertinent measurements on root length, etc. were taken.

Roots and tops were separately oven-dried at 100°C for twelve hours and oven-dry weight determined.

Soil moisture samples were likewise oven-dried at 100°C and percentage of available soil moisture calculated from moisture equivalent determinations. In addition, mechanical analyses were made on the sets of samples from each twelve inch depth.

Results

Only preliminary calculations have been made to date on these two phases. They will serve, however, to give a picture of main differences and effects.

First Year Seedling Development Phase: At the end of the first growing season (October 1):

1. The average depth of the seedling roots on the burn was 28 inches; on the virgin forest only 9 inches.

2. Root growth continued throughout the entire season while top growth practically ceased after July 15.

3. Both top and roots weights continued to increase throughout the season.

4. The total number and length of laterals continued to increase during the entire season.

5. Calculated on the basis of moisture equivalent determinations, available moisture was present on the burned area at 18 inches on all sites throughout the season and on almost all sites even at 9 inches; but in the virgin forest available moisture was present at 18 inches on the south slopes and flat aspects only until July 15; however it was present throughout the season on the north slopes.

Several-aged Seedling Phase (Cut-over Area):

1. The average root length of 1, 2, and 3 year old seedlings was 22 inches, 31 inches, and 50 inches respectively.

2. Roots on southerly aspects were longer than those on northerly aspects; heights were substantially the same.